

The Biomonitoring Program of the National Center for Environmental Health, Centers for Disease Control and Prevention

AT-A-GLANCE 1999



*Measuring toxic substances in people to
make better decisions for protecting health*



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What is Biomonitoring?

Biomonitoring is the measurement of toxic substances in the human body, specifically in blood, urine, serum, saliva, or tissues. The results of biomonitoring are used to help make decisions for protecting people from illness, birth defects, disabilities, cancer, or death due to toxic substances. For example, if you think that you have come into contact with a toxic substance, biomonitoring can help answer the following important questions:

- Did a toxic substance get into your body?
- What toxic substance has gotten into your body?
- How much of a toxic substance has gotten into your body?

- Is the amount of a toxic substance that got into your body enough to hurt your health?

Public health officials use the answers to these questions to do the following:

- Identify people who need medical treatment.
- Identify the right medical treatment.
- Prevent people from coming into contact with substances that can hurt their health.
- Evaluate how well prevention activities are working.

Biomonitoring enables better decision making for protecting health.

CDC's Biomonitoring Program

The Environmental Health Laboratory of the National Center for Environmental Health, Centers for Disease Control and Prevention (CDC) conducts CDC's Biomonitoring Program. The program includes the following activities:

Biomonitoring. The lab is capable of measuring 200 toxic substances (or their breakdown products) in human blood, urine, or serum. It can measure lead, mercury, arsenic, uranium, cadmium, benzene, many pesticides, many endocrine disruptors, polychlorinated biphenyls (PCBs), vinyl chloride, and many other substances that are known to be dangerous to health. No other lab in the world can measure chemical exposure in people as quickly and reliably, and some of the exposure measurements are done nowhere else in the world.



- More efficient • Less costly • Easy to use

Technology and test development. The lab develops instruments and tests for biomonitoring that improve the diagnosis, treatment, and prevention of disease due to exposure to toxic substances. For example, the lab supported development of the first portable blood lead analyzer. It is being used to screen children, wherever they may be located, for harmful exposures to lead. This tool increases the chances of identifying children whose health is at risk from lead and of referring them for prompt medical care when needed.

Quality assurance and standardization. CDC's lab helps other labs around the world standardize and improve their programs for measuring specific substances in humans that affect health. These activities result in more reliable test results. For example, through its Blood Lead Laboratory Reference System, the CDC lab helps other labs improve the overall quality of their measurements of lead in blood.

The lab uses its biomonitoring tests and technologies to help (1) protect public health during emergencies involving chemicals, (2) investigate possible exposure of people to dangerous chemicals, and (3) study the effects of chemicals on health.

Benefits of Biomonitoring

Identifies who is in danger. Some people are at greater risk of coming into contact with toxic substances. Researchers can use biomonitoring to find out which groups of people are in the most danger from toxic substances and take steps to protect them.

Improves actions to protect health. Toxic substances can be measured in people before and after taking actions to protect health. Comparing the levels of the substances before and after preventive actions can show whether the actions have helped improve or protect health and to what extent. Without this information, public health officials will have a more difficult time knowing whether their programs are actually helping people.

Improves decision making. Just because a toxic substance is in the environment doesn't mean that it is getting into people or making them sick. Biomonitoring provides a measure of people's *actual* exposure to toxic substances. Officials can use this data to find out whether a substance is causing a health problem, to determine how to treat the problem, and to plan how to prevent exposure in the future.

Improves emergency response. Sometimes there is an outbreak of what seems to be the same illness among many people, and the cause of the illness is unknown. Biomonitoring can be used to test people to find out exactly what is making them sick, how to treat them medically, and how to prevent future exposure.

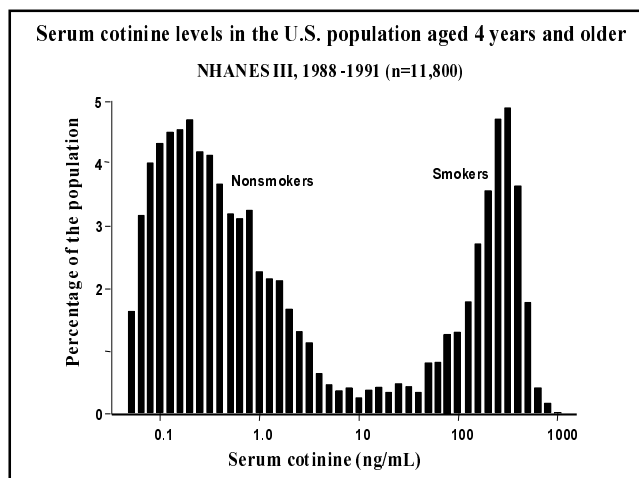
Recent Biomonitoring Results

Dieldrin. Researchers at CDC and in Denmark found that the risk of breast cancer significantly increased with increasing levels of dieldrin, a pesticide, in women's blood. This result suggests that exposure to organochlorine compounds, such as dieldrin, may increase the risk of breast cancer.

Methyl parathion. Methyl parathion is a dangerous pesticide that should never be used indoors. Over the past 2 years, it has been sprayed

illegally inside thousands of homes in at least seven states and has resulted in the death of two children in Mississippi. In response to this emergency, the lab developed a method to measure methyl parathion in urine and measured methyl parathion in more than 15,000 people. The results helped identify who needed medical treatment and who needed to be moved out of their homes until the homes could be cleaned.

Trihalomethanes. Trihalomethanes are chemicals that evaporate easily into the air and are thought to be linked to birth defects, bladder cancer, and colorectal cancer. These chemicals are often found in drinking water because they are formed during the water sanitation process. In 1998, the lab developed a method to measure trihalomethanes in blood. This method is being used in studies to find out how much of these chemicals are getting into people's bodies and whether the chemicals are causing illness.



These lab results indicate that secondhand smoke is getting into the bodies of nonsmokers.

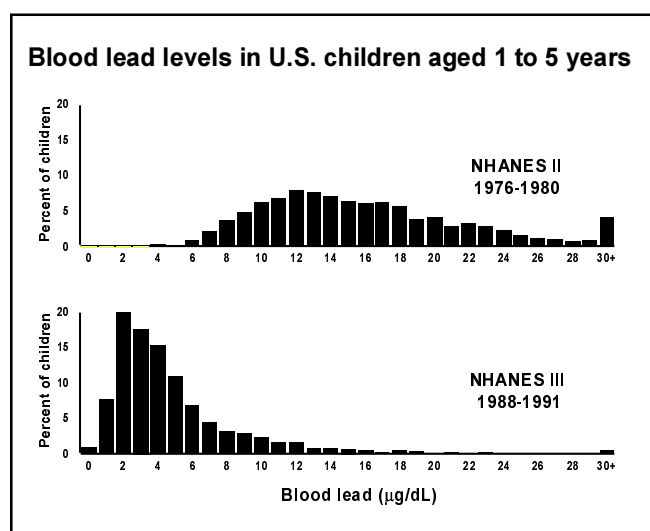
Cotinine. Cotinine is a chemical formed by the breakdown of cigarette nicotine in the body. The lab developed methods to measure cotinine in saliva, blood, and urine. These methods are being used to find out (1) how much secondhand smoke is getting into children, adolescents, and adults; (2) what levels of chemicals in tobacco smoke cause health problems; (3) how well actions to protect people from secondhand smoke are working; and (4) how well actions to help current smokers stop smoking are working.

Partnerships and Collaborations

The lab has and will continue to share with federal, state, and local agencies its pioneering work in biomonitoring to measure human exposure to toxic substances. Federal partners include the Agency for Toxic Substances and Disease Registry, the U.S. Department of Defense, the U.S. Environmental Protection Agency, the Food and Drug Administration, and the National Institutes of Health.

NHANES. In collaboration with CDC's National Center for Health Statistics, the lab has served as the central laboratory for the National Health and Nutrition Examination Survey (NHANES) since 1971. The surveys provide information on the prevalence of exposure to toxic substances and disease and risk factors for disease (including genetic risk factors) in the U.S. population. NHANES data are used to develop sound health policies, to direct and design health programs and services, and to evaluate whether these policies, programs, and services are helping to improve the

nation's health. In 1998, the lab developed analytical methods and completed the pilot phase for the next survey, NHANES IV. Work on the survey began in March 1999.



The lab has measured blood lead levels in U.S. children for more than 20 years. These graphs indicate that efforts to prevent lead poisoning of children are working and need to continue.

What's New?

Rapid Toxic Screen. The lab is developing a Rapid Toxic Screen that medical personnel will use to protect health during emergencies or terrorist acts involving chemicals. This tool will rapidly measure 150 chemicals in samples of human blood and urine. Officials will use the test to find out which chemicals are involved, who has been exposed to the chemicals, and how much of the chemicals have gotten into people. Medical personnel need this information in order to respond quickly enough during chemical emergencies to save the lives of those exposed and to protect those not yet exposed. The lab is working to develop tests for the first 50 chemical agents for the Rapid Toxic Screen in 1999.

National Exposure Report Card. Each year the lab plans to measure and report the exposure of the U.S. population to 25 priority toxic substances. By comparing the results over time, public health experts will be able to see how health is being positively or negatively affected as levels of exposure to toxic substances in the environment change. The lab will report the data according to the age, sex, race/ethnicity, geographic area, and income level of the people tested to see whose health is most at risk. The annual report card will be used to identify exposures to toxic substances that can hurt health, to identify whose health is most at risk, and to monitor how well actions to prevent exposure are working. The lab's goal is to expand the report card to cover 100 priority toxic substances per year.



Examples of Chemicals To Be Detected Through the Rapid Toxic Screen

- Nerve agents
- Sulfur and nitrogen mustards
- Hydrogen cyanide
- Lewisites
- Heavy metals
- Pesticides
- Volatile organic compounds
- Dioxins

Support for States. Many Americans are concerned that they are being exposed at home and at work to substances that can cause cancer and other diseases. States are frequently called upon to investigate geographic clusters of cancer, birth defects, and other diseases and to find out whether exposure to toxic substances causes these health problems. The lab's biomonitoring results and exposure

profiles for geographic areas will help states answer these questions. The lab is also developing less expensive, simple-to-use, and more rugged biomonitoring methods for state labs to use. In the future, CDC would like to increase support for the number of state and local health and exposure investigations to 50 per year.

Other Environmental Health Laboratory Activities

Besides biomonitoring-related activities, CDC's lab conducts activities that help ensure better diagnosis, treatment, and prevention of selected chronic diseases.

Quality assurance and standardization. In addition to ensuring the quality of blood lead measurements, CDC's lab provides quality assurance, standards, references, and technical assistance through the following programs: (1) the CDC Lipid Standardization Program for assisting labs in measuring lipids and cholesterol, which are factors in cardiovascular and other diseases; (2) the Newborn Screening Quality Assurance Program for assisting labs in conducting tests to detect treatable, inherited metabolic disorders such as sickle cell disease; (3) the HIV Quality Assurance Program for assisting labs in detecting antibodies for HIV in dried-blood-spot specimens; and (4) the Diabetes Reference Laboratory Program for improving the diagnosis, treatment, and prevention of diabetes.



NHANES and nutrition. The lab not only measures the levels of *toxic* substances in people for NHANES, but also measures *nutritional* factors that can cause or decrease the risk of disease. These measurements are important in assessing the health of the U.S. population and in preventing disease. The lab also performs a quality assurance role for NHANES measurements.

National DNA Bank. For NHANES, the lab collects and preserves DNA from a nationally representative sample of the U.S. population. This National DNA Bank is unique and valuable for determining the prevalence of genetic risk factors for disease in the population and for conducting research on genetic risk factors.

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